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EOLE BALLOON PROJECT
REPORT ON TESTS OF PROTOTYPE EQUIPMENT: DESTRUCTOR

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I. DEFINITION OF DESTRUCTOR (REVIEW) /2

The operational destructor is the device made up of an electric cable detonator mounted in a detonator-support plug. The end of the cable wires (coiled) are equipped with connectors and shunted.

The detonator-support plug is later screwed into a valve attached to the lower part of the balloon gas bag. Firing the detonator causes the destruction of the valve.

1.1. Technical Specifications

Detonator

Type DF 68 ATS

Miniature electric device with a detonating charge

Charge

- 57 mg lead nitride
- 50 mg hexogene

Weight (with cable)

- 3.5 grams

Cable

- Wire (AIR 1722-0.2 gauge AWG 24) coiled - length 200 mm
- Heat-contracting sheath
- Encased Deutsch Jiffy Junction connectors
- Deutsch shunt

Electrical Specifications

- Fuse-bridge resistance: $1{,}4 < R < 2\ \Omega$
- Insulation resistance between shunted wires and the body of the detonator; $> 10\ M\Omega$ (50 V DC)
- Nonfunction threshold: 0.3 V DC
- Nominal ignition impulse: 1.5 A/20 ms

Detonator-support Plug

Machined part in DELRIN last screwed on to the balloon valve.

1.2. Conditions of Acceptance

The tests are carried out by the manufacturer in the presence of representatives of the C.N.E.S. (National Center for Space Studies). /3

- Appearance check (100%)
- Dimensional check (100%)
- Environmental tests (50%)
  - Vibration tests: sine wave vibrations of 1 mm amplitude and 50 Hz frequency for 30 minutes in two perpendicular directions.
  - Climatic environmental tests: two successive cycles:
    - Heat: temperature +45°C
      relative humidity 95%
      period 3 hours
    - Cold: temperature -70°C
      period 3 hours
- Electrical Checks (100%)
  - Fuse-bridge resistance
  - Insulation resistance
- X-ray checks (100%)
- Safe operation checks (50%)
  - Operation time
- Checks on power generated (50%)

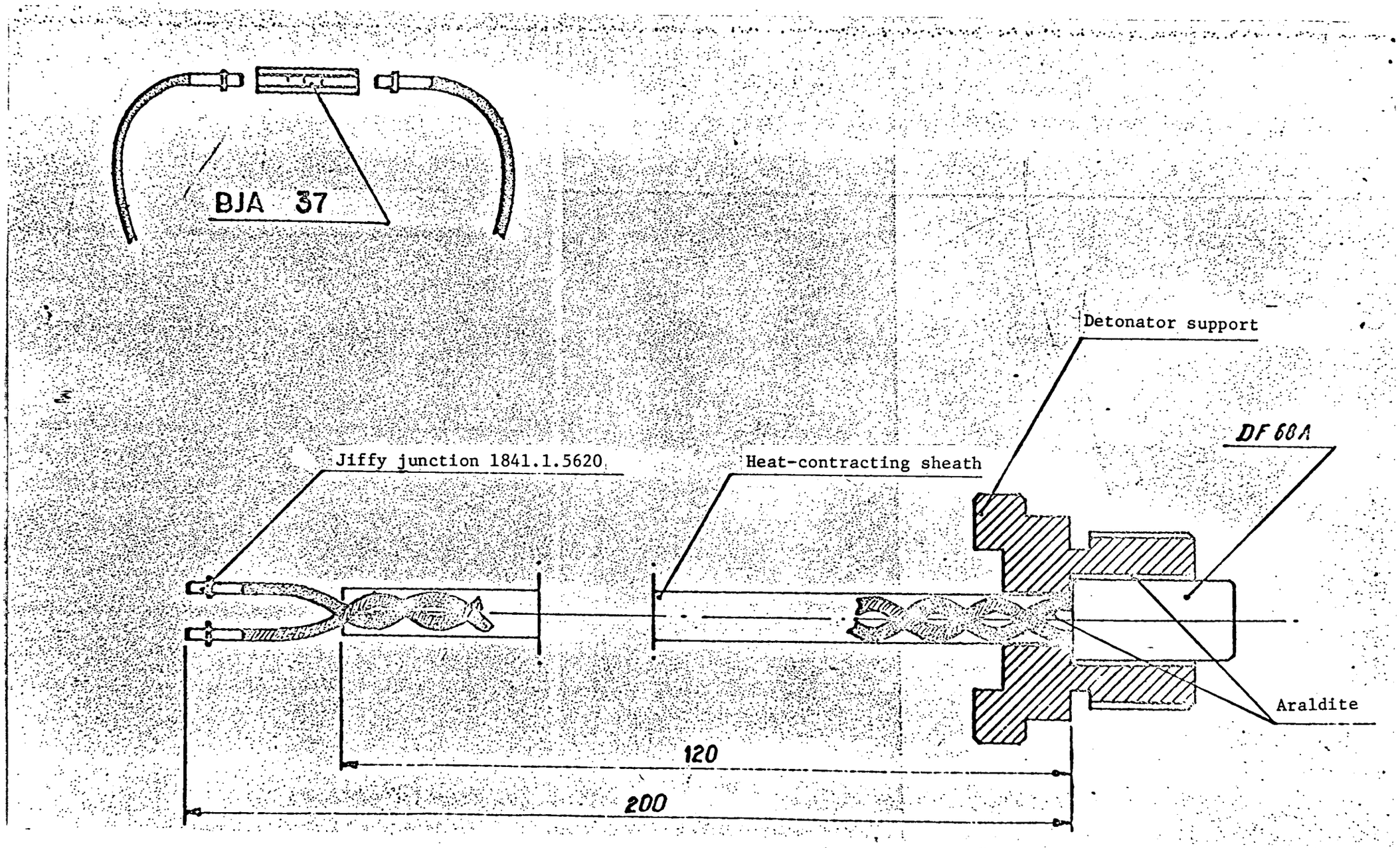

Figure 1. Operational destructor.

2. PERFORMANCE CHECKS

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2.1. Performance Checks on the Operational Unit

2.1.1. Purpose of test

To test power by puncturing a lead sheet.

2.1.2. Type of equipment tested

Operational unit.

2.1.3. Apparatus utilized

Lead disks of quality B Ø 31 mm thickness
Thickness: 3.4 mm

Assembly equipment.

Ballistic chamber equipped with a photomultiplier tube or a photoelectric cell to measure operation time.

Feeding: ignition impulse generator.

2.1.4. Procedure

- Operational unit is mounted on test equipment.
- Lead disk is put in place.
- Above is placed in ballistic chamber.
- Firing.
- Puncture diameter is checked.

2.1.5. Results

Tests performed on a total of 55 operational units.

The 55 lead disks were pierced, the puncture holes measuring between 5.5 and 6 mm.

2.1.6. Conclusion

This method allows us to verify the power of the destructor.

2.2. Balloon Destruction Tests

2.2.1. Purpose of Test

Balloon destruction tests by means of the operational unit, operated from the ground.

2.2.2. Type of Equipment Tested

Operational unit, valve and balloon.

2.2.3. Apparatus Utilized

Firing line

Firing impulse generator

2.2.4. Procedure /5

- Installation of valve on balloon.
- Inflation of balloon.

  1/3 helium
  2/3 nitrogen
  10-20 millibars excess pressure.

- Checking of detonator and ignition line.
- Placing of detonator in valve.
- Simulated firing with burners.
- Connection of detonator.
- Firing.

2.2.5. Results

The valve is sheared off flush with the clamp nut; the balloon is not damaged. Excess pressure is immediately eliminated by a significant escape at the level of the resulting hole (Ø 15 mm). The balloon is not deflated immediately as a helium "bubble" remains in the upper portion.

2.2.6. Conclusion

Provided with such an escape, the balloon will not fail to come down. This method of destruction guarantees a maximum descent speed of no more than 2 m/s, avoiding all risk of a rough fall.

3. CLIMATIC ENVIRONMENT TESTS

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3.1. Purpose of Test

To verify the qualifications of the operational unit at the same level of those of all other EOLE-BALLOON equipment.

3.2. Type of Equipment Tested

Operational unit and valve

3.3. Apparatus Utilized

EOLE climatic tank: high and low temperature cycles, variable pressure and humidity.
Heat tank: high and low temperatures
Safety milliohmeter
Ballistic chamber
Firing impulse generator

3.4. Procedure

- Operational units installed in the balloon valves.
- Detonators placed in series and attached to the bulk of the climatic tank by a medium with a resistance of 10 K Ω.
- Equipment subjected to 10 successive 24-hour cycles (see Figure 1).
- Removed from tank, they are subjected to heat reconditioning: high or low temperature

+30°C 6 hours, effective 10
+60°C 6 hours, effective 10
-30°C 6 hours, effective 10

- Electrical checks:

  Fuse-bridge resistance
  Insulation resistance

- Ignition
- Checking of destruction effects

3.5. Results

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The 30 detonators fired worked properly. The preignition electrical checks and those following heat cycling showed no variations in functional characteristics. The 30 balloon valves were destroyed in a similar manner, a hole averaging Ø 15 mm produced in the center of the valve allowing the balloon gas-bag to rise.

3.6. Conclusion

The destruction assembly is suitable for different climatic environments. Climatic environment tests on 50% of the items allows rigorous control of operating characteristics.

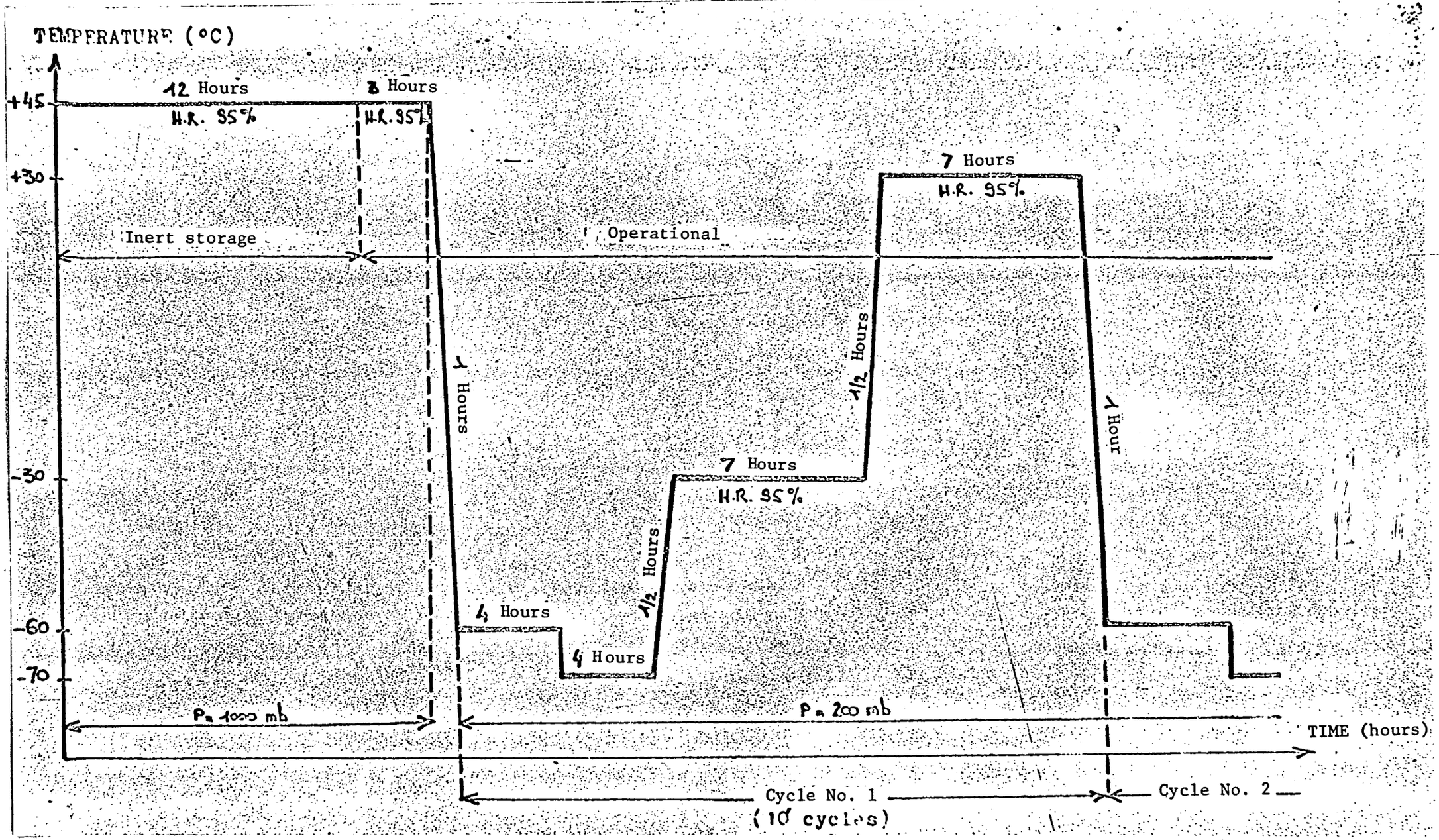

Figure 2. "Eole Cycle: climatic tests.

4. COMPATIBILITY TESTS

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4.1. Battery and Destructor Compatibility

4.1.1. Purpose of test

To test the possibility of simultaneous transmission and destruction.

One must find out if:

- The battery is capable of providing the current necessary for destruction during continuing transmission.
- The battery will not break down after the significant current draw due to destruction, preventing any signal transmission.

4.1.2. Type of equipment tested

Operational unit, batteries, transmitter

4.1.3. Methods utilized

Programmer

Recording equipment:

- Optical galvanometer recorder
- Continuous amplifiers

Firing chamber

4.1.4. Procedure

a) Preliminary phase

- Battery and programmer turned on
- Recorder started
- Drop in battery voltage and current consumption during transmission recorded with destructor not hooked up.
- Stop

b) Tests with destructor

- Installation of destructor
- Transmitter terminal voltage checked
- Destructor connected
- Battery and programmer activated
- Recorder started
- Stop

4.1.5. Results /9

Battery supplies current required for simultaneous destruction and transmission.

In all tests performed, an average current strength of I_D = 1.85 amps was found in the firing circuit.

The extremely short current draw does not break down battery voltage. The voltage drop during and after transmission is the same with or without destruction.

4.1.6. Conclusion

Battery and destructor are compatible and it is possible to have simultaneous transmission and destruction.

4.2. Gondola Electronics and Destruction Compatibility

2.2.1. Purpose of test

This test completes the preceding one and is designed to ascertain the behavior of the gondola.

4.2.2. Type of equipment tested

Operational unit, gondola and batteries.

4.2.3. Methods utilized

Recording apparatus: Memory oscilloscope

Firing chamber

4.2.4. Procedure

- Scope release verified
- Transmission without destruction recorded
- Destructor installed
- Transmission with destruction recorded
- Transmission after destruction recorded

4.2.5. Results /10

The preceding results are confirmed. The destruction impulse from the gondola is of sufficient and probably excessive amplitude.

4.2.6. Conclusion

The gondola, batteries and destruction system are compatible.

4.3. Compatibility of Ground Transmission and Destructor

4.3.1. Purpose of test

To ascertain the compatibility from the standpoint of safety of the ground transmitter and the destructor during the storage, maintenance, checking and installation, and launching phases.

4.3.2. Type of equipment tested

Operational unit

4.3.3. Apparatus utilized

H.F. Transmitter:

- output 220 W
- frequencies used: 5 MHz and 18 MHz
- antenna-to-destructor distance: 50 meters

4.3.4. Procedure

- Destructor exposed, cable wire ends shunted.
- Destructor exposed, circuit on.
- Destructor installed on balloon valve, connected, circuit opened to control relay level.

4.3.5. Results

The purpose of the tests was to make sure that induction in the destructor circuit due to ground transmission was not enough to ignite the detonator.

No. H.F. coupling was found, in the light of the precautions taken (twisting of cable wires) and the current strength of the existing field. Note that the antenna position, aimed at the test location, was very unfavorable as this configuration is not used at launching sites.

4.3.6. Conclusion

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Ground transmission is compatible with the different operations affected by manipulation of the destruction systems.

REFERENCES

- Technical Clauses on Prototype Acquisitions
  70/TA/MM/EOLE.B/304

- Balloon Destruction Tests
  68/SL/EOLE.B/145

- Performance Checks on the Operational Unit
  ATS/REP/70/36

- Environmental Tests
  70/TA/MM/EOLE.B/245

- Battery and Destructor Compatibility Tests
  69/TA/MM/EOLE.B/188

- Gondola Electronics and Destructor Compatibility Tests
  70/TA/MM/EOLE.B/440

- Ground Transmitter and Destructor Compatibility Tests
  70/TA/MM/EOLE.B/514

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